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“What one man calls God, another calls the laws of physics.”

-Nikola Tesla

# TOPIC 15: SOUND

THE ABOUT

# CHAPTER ANALYSIS



MASTERY

- Relatively easy topic
- Take note of echo questions and calculations



EXAM

- Tested in MCQ mainly, some Section A questions
- Closely linked to chapter like General Properties of Waves



WEIGHTAGE

- Light overall weightage
- Constitute to around **2.5%** of marks for past 5 year papers

KEY CONCEPT

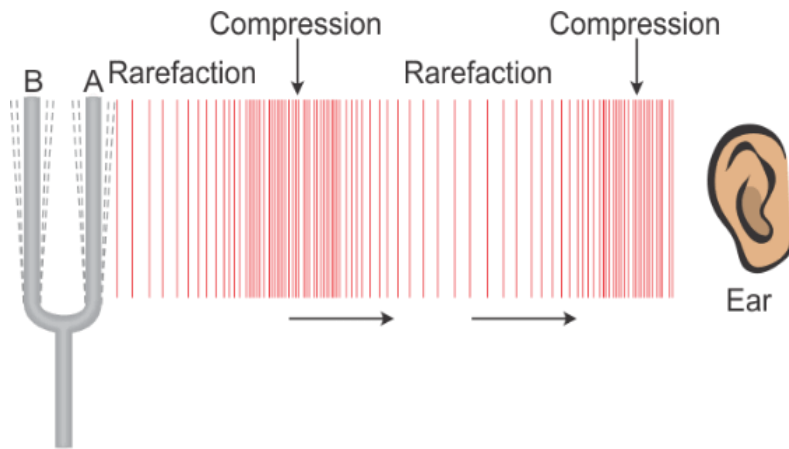
# SOUND WAVES

## SPEED OF SOUND IN MEDIUM

### ECHO



# SOUND WAVES



When vibrating object alternately pulls or pushes on the layers of air adjacent to it, it causes small but rapid changes in air pressure.

**Compressions** are regions where particles are pushed closer together, resulting in higher pressure.

**Rarefactions** are regions where particles are pulled further apart, resulting in lower pressure.

## SOUND WAVES

Sound waves are propagated as **longitudinal waves** whose particles vibrate parallel to the wave motion direction.

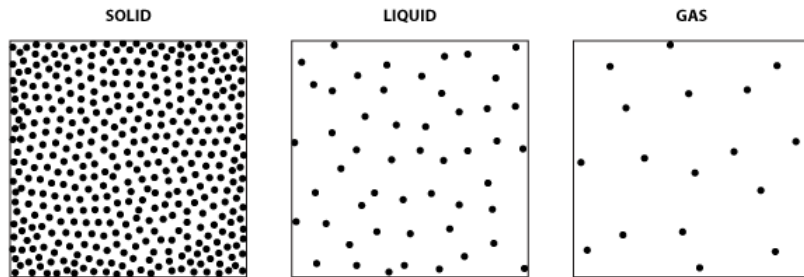
Sound waves are mechanical waves, as they require a **medium to travel**.

The source of a sound wave is by a **vibrating source**.

It can be produced by vibration of objects, eg drum, tuning fork, vocal cords.

# SOUND WAVES

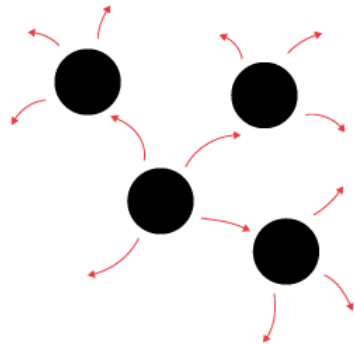
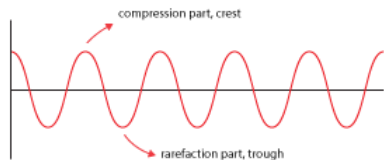
## Mediums for sound to create vibrations



When a vibration occurs by sound, molecules in the medium start to vibrate and transmit that energy through other molecules.

Distance between molecules in solid mediums are the smallest. The 2nd is liquid and the 3rd one is gas.

So, sound energy travels much more faster than the other mediums in solid mediums.



## SPEED OF SOUND IN MEDIUMS

Sound travel faster in denser mediums as energy is transferred more quickly between particles.

Hence, sound travel fastest in **solid > liquid > gas**.

Medium	Speed / ms <sup>-1</sup>
Vacuum	0*
Air	330
Water	1500
Steel	5200

**\*Sound does not travel in a vacuum.**

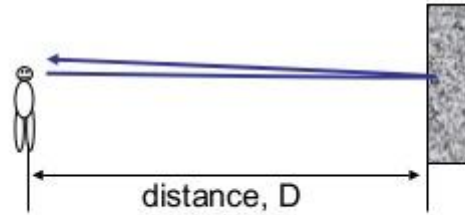
# ECHO

## Reflection of sound

An **echo** is a reflected sound wave.

*Question:*

*A misguided child shouts 'Barca!' at a nearby cliff and hears an echo 1.4 s later. How far away is the cliff?  
Take the speed of sound = 340 m/s.*



The sound travels to and from the cliff, a total distance of  $2D$

**$speed = distance / time$**

becomes:  **$distance = speed \times time$**

$= 340 \text{ m/s} \times 1.4 \text{ s}$

$= 476 \text{ m}$

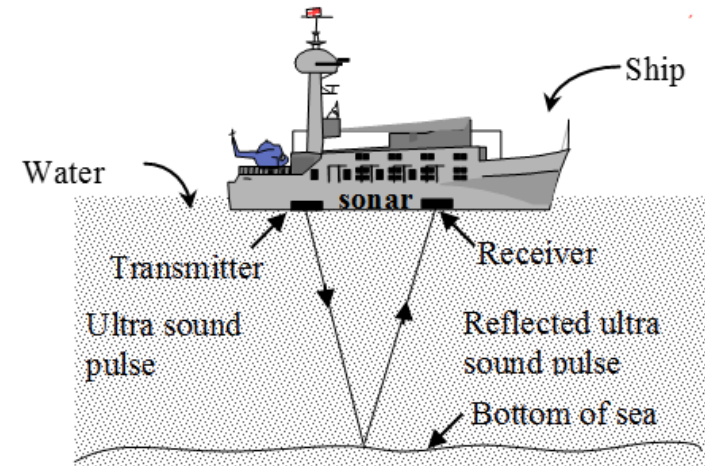
$= 2D !$

**Therefore distance to the cliff = 238 m.**

## ECHO

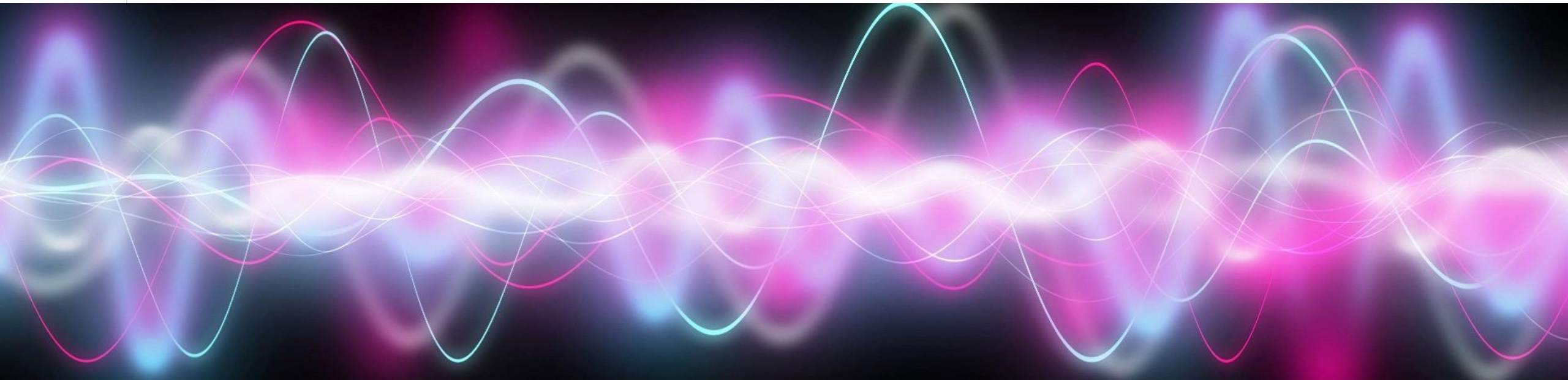
When a sound wave is reflected by a large, hard and smooth surface, an echo is produced.

$$\text{Speed of sound} = \frac{\text{Distance}}{\text{Time}} = \frac{\text{Distance by echo to surface \& back}}{\text{Echo Time}}$$



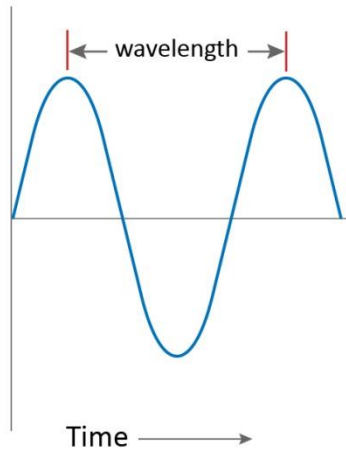
KEY CONCEPT

# PITCH & LOUDNESS

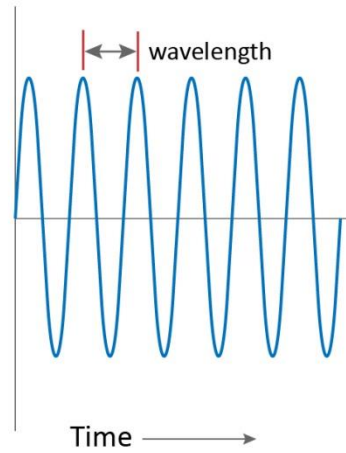


# GRAPHIC REPRESENTATION

## Low pitch

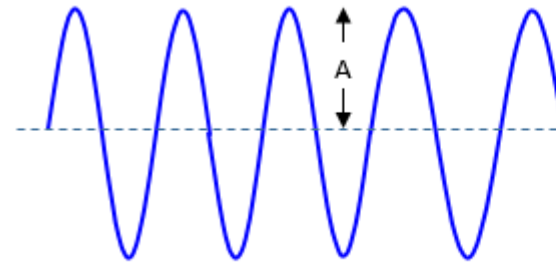


## High pitch



## PITCH & LOUDNESS

**Loudness is measured by amplitude** & is a measure of the amount of energy carried by the sound.

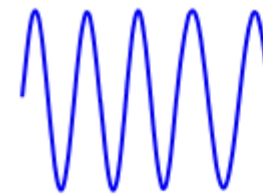


A loud sound – large amplitude



A soft (quiet) sound – small amplitude

**Pitch depends on the frequency** (number of waves formed in 1s).



A high pitched note – high frequency



A low pitched note – low frequency



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